"THE NEW AGRICULTURE."

By BURNET LANDRETH.

(*Read May 4, 1906.*)

The use of Peruvian guano and other concentrated fertilizers may be said to have been the initial steps leading to a new birth of agriculture.

Peruvian guano was introduced about one hundred years ago, but did not get into general use until about 1840, at about which time was introduced into frequent use ground bones and super-phosphate of lime, two manurial agents which have accomplished more than any other soil fertilizers, and at the same time into partial use nitrate of soda and nitrate of potash; all these objects of fertilizing force being greatly concentrated in comparison with the bulky fertilizers of earlier years, manures which still are highly valued, but such as cannot be profitably transported long distances. The use of these concentrated fertilizers in Europe increased the area of the sugar beet fields to an enormous extent as well as the area of everything else in the agricultural line.

In America, by these very rapid and cheap methods of adding plant foods to the soil, so-called fertilizer factories sprung up in all directions over the land and the crops of grain, cotton, tobacco, and other productions of the garden and field were doubled in product per acre as well as quadrupled in area. This subject of fertilizers, however, may be looked upon as a back number, or as hardly now to be classed in the process of "the new agriculture," but increased crops led up to other developments. Neither can steam plowing be looked upon as a new process of "the new agriculture," for it was practically pursued fifty years ago largely in England and Germany and to some extent in Egypt, but it broadened immensely the scope of agricultural practice. In America, however, steam plowing in early days never took a very prominent place, because until of late years there were few great American farming estates

operated by wealthy and very progressive men, it not being profitable to steam plow at one operation less than a field of forty or fifty acres, but of late years consequent upon the rapid extension of agricultural operations, especially in wheat growing, fields of grain have become so immense as to satisfy the most progressive. In England the system of plowing is distinct from what Americans have always clung to, even although up to quite lately with disappointing results. In Europe the system is altogether what is called the cable or rope system, where upon a field preferably not less than four hundred yards long a traction engine with a large horizontal revolving drum beneath the boiler has placed opposite to it at the other end of the field a corresponding heavily anchored revolving horizontal drum. Around these two drums passes a wire cable of about three fourths of an inch thick, which drags backward and forward a gang of plows of six, or even ten or twelve mould boards, an automatic device, after each set of furrows are turned, moving forward the anchor at the far end; the steam engine on the headland also moving forward to the same distance as the anchor, so that they are always on parallel lines. One engine and opposite anchor windlass forms what is termed the "single system," while in the "double system" there are two opposite engines.

These plowing outfits cost from ten to twenty thousand dollars, an amount which only can be assumed by a large operator. Not more than four or five of these outfits have been imported, one in the neighborhood of Philadelphia being imported by Colonel Joseph Patterson, who thirty years ago endeavored to establish a beet sugar farm and factory at Egg Harbor, N. J., which operation on account of unfavorable climatic influence was a failure, the plowing apparatus being subsequently sold to Wade Hampton, thence to Cuba.

Americans have wanted something cheaper, something easier to manage, and have spent large amounts of money in endeavoring to plow by *direct* action, using self-moving engines on three or four wheels pulling after them gangs of plows, just as a locomotive pulls a train of cars. This process up to a few years past met with so many difficulties, that really there were few thoroughly satisfactory applications of the American idea, for at seasons when the land is

muddy and slippery the tractive force of the engine is reduced greatly, sometimes entirely nullified, at other seasons when the soil is dry and dusty, the engine kicks up such a dust as to ruin its own working parts.

Some years ago I had considerable experience in endeavoring to promote the direct traction system and devoted much of the three successive summers in 1872, 1873 and 1874 in an endeavor to do practical work.

I worked first with a three-wheeled Scott-Thompson engine with solid rubber tires, six inches thick for the purpose of increasing the tractive force, which tires flattened out under the weight of the engine as does a cat's foot. The two driving wheels were of a sixteen-inch face having clamped upon them segmental lags or blocks of rubber; as the whoeels revolved these rubbers flattened under the five-ton weight of the engine and gave a tractive grasp of the soil of quite four hundred superficial inches under each wheel. I also worked with a four-wheeled rigid-tire engine, the periphery of the wheel fitted with angle irons to increase the tractive power.

Succeeding these trials, or in the year 1887, General Roy Stone in my farm wheel-wright shop at Bloomdale invented and erected a steam digger of ten spades, a system established on a horizontal shaft, the spades jabbing into the earth directly in the rear of the engine. This required such an immense amount of power that we turned to something better; this being a rapidly revolving shaft actuating fifty or more cutting or chopping knives slicing off slivers of earth by a downward centrifugal movement just as a wood planing machine by a horizontal centrifugal movement chips off slivers of wood. These fifty knives, each on a distinct arm eighteen inches long, were fastened to a horizontal shaft revolving rapidly, throwing forward the various arms in centrifugal movement, the knives at the ends of the arms going down into the earth in oblique and curved direction, throwing the earth six feet behind the machine as a hay tedder throws back the grass, the knives always keeping open a broad trench beneath and behind them.

The land, when thus worked, was left as a perfect garden bed, needing no further working because it formed a bed of chippings ten

inches deep and perfectly level, every particle of soil cast back quite three or four feet from its original location; but the machinery was not perfect; no one at the time was ready to take it up; consequently, the engine was sold for another purpose and the chopping apparatus went to the scrap pile.

A photograph of the Bloomsdale steam chopper gives a partial idea of the best steam chopper ever used, and I take great credit that it was developed on my own farm. It was an ideal machine, but perhaps more theoretical than practical. This was in the years 1887 and 1888.

Since then there has been a great advance in methods of steam plowing by direct traction, and that by the western people, always leaders, if not in the invention, certainly in the adoption of all new machines and appliances, and they have not been laggards in perfecting the American idea as connected with steam plowing, for it has rested with a California establishment to most successfully promote the system of direct traction plowing.

This establishment makes a sixty-horse power traction engine which draws a gang of twenty-one earth-cutting disks, each cutting a foot wide and nearly a foot deep and doing in this style fifty acres a day, sometimes eighty acres.

In England no double engine cable system has ever done anything like this, and in addition the traction engine has sufficient power to drag at the same time a gang of grain sowers which seeds the same width of twenty-one feet. The engine makes its own electric light, so that operations can be conducted throughout the full twenty-four hours. One of these machines is in use in South Africa.

And there is another case of most remarkable development in agricultural mechanism, my reference being to harvesting machines, and this again by western people, who, by reason of their enormous breadths of ground and scarcity of labor, have always been very active in promoting the use of labor-saving machinery.

Many farmers in Minnesota and the Dakotas have for years been winning the admiration of the old east by using thirty and forty improved reapers at one time in the same field, all attended by traveling machine shops to effect repairs, but it has been left to a

Californian to devise a perfectly practical machine for cutting, threshing, cleaning and sacking all at one operation, the grain being made ready for market five minutes after the machine touches the field.

This machines requires the united power of thirty to forty horses, still better that of a traction engine, which by its electric light turns night into day. The machine will take care of five acres an hour or over one hundred acres in the twenty-four hours. These machines are used in California, Washington and Oregon, districts where the grain thoroughly matures on the stalk and where no rain occurs during the harvest season. The outfit costs $8,500, and one farmer in Spain has had nerve enough to purchase the full system.

And what other remarkable advances in farm implements, few of them as impressive as the steam plow or the combined harvester, but in their places equally as important. It would be too comprehensive a subject to endeavor to refer to them all, but as examples will name the corn stalk cutter and binder which handles a crop of corn much as a grain binder handles wheat or rye, or the corn husker which handles a standing crop of corn, assorting all stalks and husking the ears.

These mechaines are of special importance, for be it remembered, there is annually grown in the United States two acres of corn to every man, woman or child.

A later development of "the new agriculture," but not a novelty in practice, is the process of spraying or washing the stems and foliage of plants with liquids containing poisons for the destruction of insect life. This was introduced about 1870, and was at once found very practical in checking the ravages of many kinds of insects; but countrymen noted that there were certain other insects which were not killed; they observed some which seem to delight in a poison bath, some which put on the top surface of an open barrel of paris green seem to be more lively in the morning than they were the night before. This, brought to the attention of entomologists, elicited the information that there were two great classifications among insects which must be recognized by the farmer. Firstly, those which ate the tissues of plants, and, consequently, took into

their stomachs any poisons which accidentally or artificially rested upon the outer surfaces of the plants; while secondly, there were other insects which entomologists had recognized for one hundred and fifty years, but which the farmer had never critically observed, which did not masticate their food, those after the order of the mosquito, sap suckers, having a little pumping apparatus which they inserted beneath the cuticle of stem or leaf and drew out the sap, ignoring entirely any application of poison.

The entomologists advised the adoption of a different policy, saying that these sapsuckers must be strangled, and the way to do that would be to spray them with some liquid of an oily, caustic or soapy basis, because insects do not have lungs, in the ordinary understanding of the term, but breath through orifies along the sides of their bodies or abdomens sometimes covered by scales as in the case of the fish-like lamina of the honey bee. The entomologists told the farmer that an oily spray put upon these or, indeed, any other insects, would gum up the orifices and the insects, consequently, die. Thus, between the surface application of poisons for the tissue-eating insects and the application of oily fluids for the sap suckers, most insects can be kept in check.

The insect now attracting most attention on the part of the fruit growers is the San Jose scale, a native of China, believed to have been brought to California on imported trees. These insects have by gradations of progress eastward covered the entire country, and if left alone would destroy every fruit tree in the land. But very practical steps are now being taken everywhere to eradicate this insect by the application of a liquid combination of lime and sulphur, which is caustic in its action, killing most of the half-grown hibernating scale insects in winter, and preventing the settling of any young that may come from the few parent insects escaping the wash.

As much as forty years ago scientific men indicated to seedsmen the use of several insecticides, principally carbon-bisulphid for the treatment of weevil-infected seeds, or for the treatment, in fact, of any seeds bearing on their surfaces or within them insects or mites. Seedsmen and grain merchants are especially annoyed in the conduct of their business by the depredations of the weevil family which

burrow or ensconce themselves notably in the seeds of peas or beans, corn or wheat. These grubs may be killed in their holes by the fumes of carbon bisulphid, to effect which the seedsman erects a room say thirty or forty feet square, lined top, bottom and sides with tin and with a door which can be hermetically sealted. Such a room can be loaded up with a carload, say six hundred bushels of peas, beans or anything else.

A carload of peas or beans thus treated and subjected to the fumes from a gallon of the liquid for thirty hours may then be taken out with all the larva killed, the fumes penetrating not only to the center of the pile, but to the center of every sack. The odor of the fumes soon dissipates, leaving no resultant injury to seed vitality nor to edible properties of either seeds or food stuffs: A more efficient agent is hydrocyanic acid gas, but it is dangerous in the hands of ignorant people.

About 1860 the use of carbon bisulphid was introduced among the vineyardists of France as an agent to arrest the ravages of the phylloxera, a plant louse feeding on the roots of the grape-vine. Possibly at this date 300,000 acres of vineyards are being annually treated, a half ounce of a liquid being applied by injection to every square foot of soil surface, the vapor filling all the soil interstices, the application being two treatments of ten days apart.

But an entirely new practice based upon scientific observations and a rather amusing contribution of science to agriculture is the introduction of cannibal bugs, sorts which do not injure vegetation, but luxuriate on the meat of other species of bugs. Some of these precious insects have been imported from China and are doing a fair amount of work on the California coast, while certain imported Mexican ants are very active in Texas cotton fields, feeding upon the cotton boll worm and its eggs. Thus science, while going hand in hand with agriculture, encourages cannibalism.

The farmer again had to turn to scientists to learn how to arrest the injuries from fungus diseases on his growing plants of grain, vegetables and fruits, and there has grown up a large industry in the manufacture of fungicides, principally copper compounds, which are sprayed upon the plants the same as are the insecticides. In

fact, as a matter of economy of application, both fungicides and insecticides often can profitably be mixed and the plants treated by one operation. All designs and sizes of apparatus for the application of insecticides and fungicides are now made ranging from the small air gun to cumbrous four-horse trucks carrying tanks and powerful pumps and requiring the attention of several men—some forms of dust spraying apparatus being made for hillside use, where it would not be practical to haul great weights of water.

The electric light as a forcing agent is used to advantage in stimulating the growth of vegetables and flowers. Some market gardeners in the vicinity of Boston, Mass., finding that its use pays them a profit by influencing a never-ceasing growth of lettuce, radish, cucumber and some other table vegetables, the plants not being allowed any rest day or night, but kept under a continuous activity which in the end amounts to about a ten per cent. shortening or hastening of the period of maturity, that is to say, plants which under ordinary circumstances would take thirty days to arrive at marketable condition, will under the electric light process be fit for market in twenty-seven days, which earlier maturity results in a profit, and allows space and time for an additional crop in the year's series.

These Boston men also apply continuous currents of electricity passing from end to end of plant beds in their glass houses, which is found to have a stimulating effect on the productivity of the soil. They have successfully accomplished what many others have failed to do. Even as far back as 1866 electric stimulation of the soil was tried most extensively and expensively. In that year I visited Tipptree Hall, the estate of Alderman Mechi of London, where were conducted most extensive electric experiments on field crops covering broad areas, but the so-called electric experts of that day failed entirely, although Mr. Mechi was lavish in his expenditures.

Nitroculture while several years pursued may be classed as one of the novelties in agriculture practice.

Ages ago the ancients were aware that certain plants increased the fertility of the soil, as for example clover, beans, vetches, and other legumes, but the most intelligent did not know why, simply

knew of the favorable results. Later on, intelligent observers concluded that it was because of the deep rooting habit of plants of the legume family; that it was entirely the result of the collection out of the three, four or five feet depth of soil to which the roots reached, of all the potash there which was seized upon and drawn up by the roots and concentrated near the crown within an inch of the surface, and, no doubt, to an extent the theory was correct, but scientists now tell us a new story and a most interesting one. No intelligent farmer has failed to observe upon the roots of his clover or bean plants that occasionally there is presented to his view a something which looks like a diseased condition of the roots, a growth of warts or nodules, sometimes four or five to a plant and sometimes a hundred. Occasionally this will occur at one end of the field and not at all on another field.

The bacteriologists now tell us that these nodules are caused by the attachment to the roots of plants of the leguminosæ family of certain bacteria, that these bacteria within the resulting nodules or swellings absorb out of the air of the soil a portion of its introgen and store it for the support of the growing plant itself, as also for the succeeding year's crop and this stored nitrogen is now said to be the principal secret of the imparted fertility to soil by the cultivation of a crop of clover.

Some parties are now commercially developing these micro-organisms, offering for sale in small sealed tubes portions of the living cultures sufficient to develop an indefinite quantity, just as a yeast cake which one may carry in his pocket may leaven sufficient dough to inoculate a large amount. The commercial preparations being mixed as directed in water, the solution may be used to inoculate as much soil as the solution will moisten, and this soil afterwards mixed with four or five times its bulk, and the whole thinly spread broadcast over that portion of the field to be inoculated; or the system now most generally advised is to inoculate the seed before planting it by subjecting it to a spraying or a bath. The seed may be partially dried before sowing, or sown in its wet condition.

The practice so far, to a large extent, is experimental, there being various degrees of success and failure, but the day is close

at hand when better results will be obtained. Little benefit results to any particular crop if the bacteria of that crop is already present in the soil, and little benefit if the soil is already well charged with nitrogen, or very deficient in potash or phosphate. Inoculation is only one factor in securing a successful growth of legumes and unless the soil conditions are favorable to the multiplication and activity of the bacteria, inoculation will be ineffectual.

Now as to the use of chloroform in plant culture. This is a process, only a few years introduced, of forcing the blooming of plants away ahead of their natural period, as for example making lilacs, azaleas, lilies of the valley, hyacinths and violets burst into bloom at Christmas time instead of their natural period about two or three months later. This system is well established in Germany, Belgium and France, and will, no doubt, be practiced in all parts of the world.

It is not a new thought to say that all plants must undergo a season of repose, a repose induced by some internal and external force, the plants seemingly being dead, there being no perceptible movement whatever excepting a slow increase in the size of the buds. All country people have observed that after a fruit tree loses its leaves unusually early in the autumn that it sometimes bursts into bloom before winter; it has had its season of repose, a short season it is true, but it undertakes then to proceed with further development. Now to force or intensify an early repose or sleep, chloroform is used. The susceptibility of plants chloroformed is an interesting discovery, all plants being similarly effected much as in the case of animals; it is even claimed chloroform puts metals to sleep. A test can easily be made with a sensitive plant or mimosa, placed under a bell glass with a small sponge dipped in chloroform; after a few minutes the plant will be observed to have lost all its sensibility, but when exposed to the open air, the sensibility returns. The exposure of plants to chloroform produces on short notice a most intense and deep rest, similar to that after the autumn shedding of their foliage, but a rest far deeper than under the ordinary circumstances. It has been observed that plants which had been exposed to cold and dry winds are likely to bloom early, alpine plants for example, and it is observed that the action of chloroform

produces a drying up of the tissues rendering the buds quickly susceptible to subsequent heat and moisture. This discovery opens up a broad field for the producing of blooms ahead of time as also a guarantee for the gathering of early crop of fruit. Of course, these processes can best be done in properly prepared chambers or glass houses, but, no doubt, means will be devised for covering outdoor plants with something similar to hugh bell glasses for treatment by chloroform.

One of the latest scientific discoveries in connection with agriculture is that of the influence of electric air currents. Travellers in far northern regions have noticed a wonderful rapidity of growth and brilliancy of coloring to the arctic flowers and a strength of perfume. They have noticed that succeeding a snow surface there will, forty or fifty days after its disappearance, be developed a growth of natural grass, as tall as would be produced in four times the period in temperate regions and this on poor soils. They have noticed that these growths are even still more astounding throughout spring months of unusual auroreal disturbances. Usual auroras occur about once every ten years, and in those the growths of all vegetation is far in excess of the ordinary years. This has been especially noticed in northern Sweden and Norway. Cutting down a tree there, it is observed that the annual rings about every ten years are much broader than those before and after. All this has led close observers to believe that these unusual growths are a consequence of electrical air currents, and with that theory in view most interesting experiments have been conducted proving that the theory is correct.

Professor Lemstrom, of the University of Helsingfors, was the first in these experiments, which experiments have been pursued at Avidaberg in Sweden and at Kryschanowitz in Germany and at Durham College in England, all proving conclusively that electric air currents greatly forward the growth of plants. In some cases not only ten and twenty per cent. increase in productiveness, but in other cases sixty and eighty per cent. increased development. Strawberry plants subjected to electric air currents are increased fifty to sixty per cent. in productiveness and sugary qualities and just so

with other garden crops. It has been discovered that the electric current is ineffectual on a wet and cloudy day, and positively injurious on a very dry day.

The processes of application may be generally described as follows: A plot of ground, say forty by forty feet or larger, for example, a portion of a strawberry patch, is covered by a wire netting two feet above the level of the crop insulated on wooden posts; an electric battery upon wheels is moved up close to the edge of the wire netting and the wire of the positive pole attached to the iron netting, the negative pole plunged into the earth; the electric machine is started and alternating currents are passed backward and forward, jumping from the wire netting to the leaves and conversely from the leaves to the netting. This application of electric currents repeated at intervals, the wire netting being moved from part to part of the crop, until in the end the whole field has finally been treated. Of course, this system cannot be used over very broad surfaces, but it has been put into practical use on areas as much as of three acres. Professor Lemstrom estimated the cost of an efficient electrical machine at $500 and $150 as the annual cost of the material and extras.

A still newer, and probably the newest scientific application in the line of "the new agriculture," is the electrocution of insects, a system just patented by an electrical engineer at Odessa, and in this connection I will relate an interesting incident.

Twenty years ago I was a special correspondent of a European Ministry of Agriculture upon subjects concerning the development of agriculture in America, and on one occasion, when I was asked to report upon the phylloxera in the United States, I supplemented the report by a suggestion that it might be possible to kill the phylloxera by a current of electricity passing through the stems and roots of the grape vine. The Ministry of Agriculture in office at that date thanked me for the suggestion, but said it was impractical; yet, strange to say, this Russian electrical engineer has taken out patents for doing this very special thing. If this be so, then by electricity, capable, on the one hand, as a mighty force to rend a mountain, or of a movement soft as zephyr, it may be possible yet to destroy every bug on tree or plant, whether in the open field or in glass houses.

What I have said are generalizations very incomplete, yet they, nevertheless, indicate that the practice of agriculture and horticulture has taken a highly mechanical and scientific tone, a pursuit worthy of the most intelligent mind.

Stated Meeting May 18, 1906.

President SMITH in the Chair.

Dr. J. W. Harshberger and Mr. Russell Duane, newly elected members, were presented to the Chair and took their seats in the Society.

A letter was read from Prof. Theodor Nöldeke accepting membership.

The decease was announced of the following named members:

Richard Garnett, C.B., LL.D., at London, on April 1, 1906, æt. 68.

Prof. E. Renevier, at Lausanne, Switzerland, on May 5, 1906.

Hon. Carl Schurz, at New York, on May 11, 1906, æt. 77.

The following letter was read by PROF. GEORGE DAVIDSON, of San Francisco:

POINTS OF INTEREST INVOLVED IN THE SAN FRANCISCO EARTHQUAKE.

At the request of your Secretary I draw up this short account of some of the points of interest involved in the earthquake and conflagration of San Francisco.

I hardly know what I have already written, or where to begin to tell a coherent story, although a thousand facts have been seared upon my brain. I see the flames rising yet, 500 feet above the earth.

It really seems very long since the earthquake aroused us: it would have been forgotten by this time. It is the conflagration, its awful grandeur, and its ruin of tens of thousands of people, that staggers us with its horror, and its consequences. But San Francisco will arise from this supreme blow. We are to control the Pacific.

I cannot do better than to first give you a broad idea of the geography and orography of this part of the State; and of the ocean washing it. The general direction of the coast range of mountains is northwest and southeast from Cape Mendocino in latitude 40° 27′ to Point Conception in 34° 27′. North of latitude 35½° the range comes sharply to the ocean in two or three